A COMPARISON OF THE RCAF PHYSICAL FITNESS PROGRAM AND BOB RICHARDS' ISOMETRIC CONTRACTION PROGRAM IN RELATION TO SELECTED MUSCULAR AND CARDIOVASCULAR MEASURES

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by

Bruce Patterson Sams

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Bruce Patterson Sams

Approved by:

M. L. Waltes
Chairman of the Thesis Advisory Committee

Estes Williams
Director of Graduate Studies

Major Professor

Sydney H Andrews
Minor Professor

Eric De Groodt

R E. Thomas

DEDICATION

To the betterment of Physical Education, Health, and Recreation; and to my parents and Diane.

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

The inauguration of the President's Council on Youth Fitness by past-president Eisenhour and its continued policy by the last President Kennedy and President Lyndon B. Johnson has placed an emphasis upon physical fitness in the field of physical education. The American Association of Health, Physical Education, and Recreation has placed an emphasis on fitness throughout the country. Olympic champion, Bob Richards, has contributed to the trend of physical fitness with his Isometric Fitness program. The Royal Canadian Air Force development of its physical fitness program has also caused an awareness of this fitness trend.

I. THE PROBLEM

Statement of the problem. This study was concerned with a comparison of the Royal Canadian Air Force Fitness program and Bob Richards' isometric contraction program in relation to selected muscular and cardiovascular measures.

Delimitations. The primary objective of this study was to determine the gain of strength and cardiovascular response to exercise, if any, between the means of two groups subjected to separate methods of physical training.

Limitations. The limitations of this study were: (1) a group of forty-four white male Appalachian State Teachers College students eighteen to twenty-four years of age; (2) the duration of the program was three months with the subjects meeting one hour per day, five times a week; (3) there was no control of outside activities while the test subjects were in the conditioning program.

II. DEFINITIONS OF TERMS USED

RCAF Fitness Program. Refers to the Royal Canadian Air Force Exercise Plans for physical fitness as published in the XBX twelve-minute-a-day plan for women and the 5BX eleven-minute-a-day plan for men.[1]

Bob Richards' Isometric Fitness Program. A program set up for keeping in physical condition by use of isometrics.

Isometric Contraction. A contraction in which no movement takes place, muscle does not shorten, and there is a static contraction.[2] Of same dimensions.[3]

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[1]William I. Nichols (ed.), Royal Canadian Air Force Exercise Plans for Physical Fitness (New York: United Newspapers Magazine Corporation, 1962), pp. 51-79.

[2]Elwood C. Davis, Gene Logan, and Wayne McKinney, Biophysical Values of Muscular Activity (Iowa: William C. Brown Company Publishers, 1965), p. 133.

[3]Normand L. Hane and Arthur Osal, Blakiston's New Gould Medical Dictionary. Second Edition. (New York: The Blakiston Division, McGraw-Hill Book Company Incorporation, 1956)

Isotonic Contraction. A contraction in which both shortening and lengthening of the muscle takes place.[4] Having uniform tension under pressure or stimuli.[5]

Basic Assumptions. In assessing the results of this study, the following basic assumptions were made:

1. That the subjects participated to the best of their ability during the period of this program.

2. That no formal strenuous activity was engaged in other than during the exercise period of this program.

3. That the push-ups (dips) and leg/back dynamoter tests of the Rogers Physical Fitness Index rendered a valid and reliable estimate of the strength of an individual in relation to the major muscles of the groups tested.

4. That the Harvard Step (short method) Test was a valid and reliable test of the ability of the cardiovascular system to respond to vigorous physical exercise.

Hypotheses (Null). The following null hypotheses were tested for each experimental variable:

(1) There will be no significant difference in muscular strength and cardiovascular response to exercise using the isometric program as compared to the RCAF fitness program before and after the conditioning period.

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[4]Davis, Logan, and McKinney, loc. cit. p. 133.

[5]Hane and Osal, loc. cit.

(2) There will be no significant difference in muscular strength and cardiovascular response to exercise within the two experimental groups using the isometric program as compared to the RCAF fitness program after the conditioning period ends.

Selection of the Subjects. The subjects were volunteers from an Appalachian State Teachers College freshmen physical education class of forty-four members. The subjects were divided into two groups, twenty-two in each group. The two groups were matched as evenly as possible according to the individual strength of each subject.

Selection of the Tests. Selected items of the Rogers Physical Fitness Index were used to measure two major muscle groups of the body. The items were the leg/back dynamoter, and push ups (dips). The leg/back dynamometer was used to measure the muscle strength of the leg extensors, (Rectus femoris, Vastus lateralis, Vastus intermedius, Vastus medialis). Push ups (dips) were used to measure the muscle strength of the shoulder girdle flexors and extensors, (Arm extensors and adductors, Triceps, Litisimus dorsi, Pectoralis major, Trapezius).

Clarke pointed out that even though all the major muscles in the body were not measured by the administrator of the Rogers Physical Fitness Index, the "measure of a

proper sampling of muscle groups should be sufficient to determine the general condition of all."[6]

The reliability, validity, and objectivity of the Rogers Physical Fitness Index were first reported by Rogers in 1926. This report indicated a reliability of between .94 and .98, with a probability of .96. The reliability of the individual tests used were as follows:[7]

1. Leg strength .91
2. Push ups (dips) .96

A report of the Rogers Physical Fitness Index, written by the National Research Council of the American Association for Health, Physical Education and Recreation, stated that the objectivity of the Index is very high.[8]

The trunk curl sit up was used to measure the muscle strength of the trunk flexors, (Rectus abdominus, External

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[6]H. Harrison Clark, Application of Measurement to Health and Physical Education (third edition: Inglewood Cliffs, New Jersey: Prentice-Hall, Inc., 1960) pp. 200-201; and Sydney H. Andrews, "The Effect of Liquid Diet on Selected Physical and Mental Capacities," (unpublished Dissertation, The University of Denver, Denver, Colorado, 1965), p. 40.

[7]Frederick Rand Rogers, Physical Capacity Tests in the Administration of Physical Education (New York City: Teachers College, Columbia University, 1926), p. 26; and Andrews, op. cit., p. 44.

[8]Measurement and Evaluation Materials in Health, Physical Education and Recreation (Washington, D. C.: National Education Association, 1950), p. 130; and Andrews, op. cit., p. 44.

oblique, Internal oblique).

The Harvard Step Test (short method) was used to test the cardiovascular response to exercise.

First administration and procedure of the tests. Both of the experimental groups were administered two of the Rogers Physical Fitness Index tests, the Harvard Step (short method) test, and the trunk curl sit up under the same conditions at the same time. The tests were administered at 7:00 P.M. on two days. Strength was tested on the first scheduled day and cardiovascular response to exercise was tested the following day. Both groups were carefully instructed in the procedure of each test. Assistance was given in counting the number of sit ups and push ups (dips) by volunteer students of a physical education class in Tests and Measurements. The assistants had administered the Rogers Physical Fitness Index tests at least one time in the class. Measurement of the leg strength was done with the leg/back dynamometer, placed on the floor, and the pulse rate after exercise was counted by the use of a stethoscope.

The push-ups (dips) test was administered by the use of a stationary wood parallel bar elevated to shoulder height of each subject. The test subject mounted the parallel bar in a vertical position with palms facing medially and the subject's arms straight and locked at the

elbow. The subject then lowered his body until the upper and lower arms were at approximately ninety degrees. The test administrator visualized and used his hand by placing it at the subject's elbow to stop him from passing below ninety degrees. The subject then pushed himself back to his original position. In arriving at a score each repetition of this movement was counted as one push up (dip).

The leg extension strength was measured by the use of the leg/back dynamometer, placed on the floor. The test subject was belted to the lift chain in such a manner that the majority of the lift and weight was supported on his hips. The hip belt was adjusted in such a way as to assure the individual optimum performance. If it was necessary, the belt and/or the lift bar were readjusted for any individual. The score of the leg extension strength was recorded in total pounds lifted, as read from the dial on the dynamometer.

The Harvard Step (short method) test was used in this experimental program to determine the response of the heart, as measured by pulse rate, to vigorous exercise. The test was administered both before the conditioning began and after the conditioning program ended. The test subject was asked to step alternately from the floor with first one foot and then the other foot onto a bench that was eighteen inches high. The step cadence was counted

with a metronome. This stepping action from the floor to the bench and back to the floor was repeated thirty times a minute for five minutes. The subject was then placed on a table in a reclining position, and the subjects's pulse rate was counted by the use of a stethoscope. The pulse rate was taken for thirty seconds, beginning one minute after completion of the exercise. The time lapse between the end of the step period and the beginning of the pulse count was measured with a stop watch.

The abdominal trunk flexors were measured by the trunk curl sit-up. The test subject was in a reclined position lying on his back on the floor. The sit-up was done with knees flexed and feet on the supporting surface. The subject, with his hands interlocked behind his head, raised himself up and touched his elbows to his knees and then returned to the starting position. In arriving at the score each repetition of this movement was counted one sit-up.

Administration of the program. The program was begun with the forty-four subjects divided into two groups. Twenty-two were put on the RCAF fitness program and twenty-two put on the isometric program. The subjects came together once each day, for one hour, five days a week for three months. The exercises used in both of the conditioning programs were explained and demonstrated. At the end

of the three months the subjects were tested again using the same strength and cardiovascular tests.

Second administration of the tests. The same tests and test procedures were given again at the end of the three months period. The scores were computed and the final strength and cardiovascular response to exercise scores were shown for each of the subjects.

CHAPTER II

REVIEW OF THE LITERATURE

Through a review of the literature available in the Appalachian State Teachers College library, there were no studies found that related directly to this program. However, literature pertaining to isometric and isotonic contractions in relation to muscular development and cardiovascular response to exercise was reviewed.

I. LITERATURE ON ISOMETRIC AND ISOTONIC CONTRACTIONS AND CARDIOVASCULAR RESPONSE TO EXERCISE

Literature pertaining to isometric and isotonic contractions and cardiovascular response to exercise was divided into two sections in this review of literature. Strength being one section and Endurance the other.

Strength

It has been said what the public knows as isometric and isotonic contractions be more properly labelled static and dynamic contractions. Davis, Logan, and McKinney have stated that "isometric contraction is a contraction in which no movement takes place, the muscle does not shorten and there is static contraction and isotonic contraction is a contraction in which both shortening and lengthening of the

muscle takes place."[1] Weightlifting is basically an isotonic exercise. The weightlifter acts isometrically as he flexes his muscles an instant before lifting the bar. Likewise, every isometric contraction involves some isotonic movement, simply because of flexibility of ligaments and muscles.[2]

Higdon referred to Hettinger and Muller, two German researchers, as saying that:

> Isometric contractions produced strength gains of five percent a week. To obtain the strength-building benefits, one must reach close to complete contraction. The rules are simple: unless the person contracts muscles at least two-thirds or more of that muscles's strength, he is not going to reap the five percent benefits.[3]

Physiologists have criticized the idea that general body strength can be built by a few isometric exercises. Higdon quoted Bonder as saying:

> This is a falsehood. Isometrics are very specific. You exercise one muscle area at a time. Now, if you only have one weakness, it's quick and easy because there is probably only one muscle area you have to bother with, because isometrics are so specific you have to work all parts of the body to make sure you're getting at the whole area.[4]

Higdon lists four distinct types of conditioning as necessary in both physical education and athletic programs

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[1]Davis, Logan, and McKinney, loc. cit., p. 133.

[2]Hal Higdon, "Let's Tell the Truth About Isometrics," Today's Health, 43:58, June, 1965.

[3]Ibid., p. 58.

[4]Ibid., p. 58.

that he received from Bender in an interview with him:

> (1) Cardiovascular pulmonary efficiency, or the adaptive response of the heart blood vessels and lungs to exercise, (2) Muscular strength, or the ability to accomplish an activity at peak performance without injury. Strength is the ability to work against a specified resistance, (3) Muscular endurance, or the ability of a muscle to respond repetitively for a long period of time, (4) Flexibility, defined both as the effective use of the muscle group throughout its maximum range of motion.[5]

Studies by Davis, Logan, and McKinney on isometric and isotonic strength development show that:

> Comparative studies of isometric and isotonic strength development exercises tend to indicate that in terms of strength per se, isometric exercises are most efficient from the standpoint of the amount of time required to produce the same gains. For the individual who is concerned mainly with the development of increased strength, and, in turn, more firmness of the muscles, isometrics are most beneficial.[6]

Davis, Logan, and McKinney reported a study by Rasch concerning the effect of isometric exercise on strength of antagonistic muscles involving specificity of strength development. The study failed to show specificity of strength development.[7] Bender has worked extensively with multiple angle strengthening and testing. Davis, Logan, and

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[5] Ibid., p. 58.

[6] Davis, Logan, and McKinney, loc. cit., pp. 55-56.

[7] Davis, Logan, and McKinney, loc. cit., pp. 55-56; and Rasch, Philip J., "Effects of Isometric Exercise Upon the Strength of Antagonistic Muscles," Internationale Zietschrift Fur AgeWandte Physiologie Einschleisich Arbeit Physiologie, 19:18-22, March, 1961.

McKinney quoted Bender as saying, "An isometric contraction can develop muscular strength at any point of stimulation throughout the range of motion."[8]

Experimental research has indicated that isometric exercise may improve athletic performance. Muscular strength is directly proportional to the longitudinal cross section of the individual muscle fibers. To improve strength, heavy resistance with low repetition maximums are advocated.[9]

Murrey M. Lazier, a high school coach at Evanston, Illinois, stated the following conclusions he came to on the weight lifting and isometric program:

1. Isometrics are a supplement to our weight training program, not a substitute for the program.

2. When there is a lack of facilities, equipment, time or cooperation by coaches of other sports, isometrics will be used as a substitute for our weight training program.

3. Improvement in strength levels are difficult to measure in isometrics.

4. The amount of daily effort expended by each player is difficult to ascertain.

5. Isometrics are easy to administer, take relatively little time, and are well received by our player.

6. Isometrics are inexpensive.

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[8]Davis, Logan, and McKinney, op. cit., p. 55-56; and Jay A. Bender and Alfred B. Ferguson, The ABC's of Athletic Injuries and Conditioning. Baltimore: The Williams and Wilkins Company, 1964.

[9]Arthur H. Steinhaus, "The Physiologists Speak on Weight Lifting," Journal of Physical Education, 35:16-17, September, 1938.

7. It is possible to develop many exercises and work on most muscle groups, but care should be taken to analyze the objective and keep the exercises within a short time interval.

8. Isometrics provide good mental therapy for players who have been conditioned to a weight training program.[10]

Steinhaus says, "Isometrics are one way and only one way to overload a muscle.[11] Properly overloaded muscles will increase in strength. Isotonic contraction is in no sense the opposite of isometric contractions. Some isometrics held without tension change is isotonic. Phasic contractions whether concentric or eccentric are opposite of isometric contractions. Very few activities in which muscles contract against loads attached to changing lever proportions operating in the human skeleton, are isotonic. Every change of lengths of force in resistance calls for changing tensions in operating muscles. Coaches who use functional overload are wisest. When normal movements of a sport are overloaded the right muscles are strengthened.[12]

Rogin quoted Steinhaus as saying, "You don't have to do repetitive exercise to build muscle."[13] Rogin also

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[10]Murrey M. Lazier, "Isometrics and Weight Training," The Athletic Journal, 43:58-68, April, 1963.

[11]Arthur H. Steinhaus, "Some New Theories of Exercise, Overload, or Isometrics," The Physical Educator, 22:22, March, 1965.

[12]Ibid., p. 22.

[13]Gilbert Rogin, "Get Strong Without Moving," Sports Illustrated, 15:15-21, October, 1962.

pointed out some limitations of isometric contraction that Steihaus stated, "It does nothing for the heart and lungs. It does not increase endurance. It only increases strength, and strength is only one aspect of fitness."[14]

Elliotte quoted Obeck, a onetime professional football player now director of athletics at New York University, as saying:

> I am convinced on the concept of isometrics. It is good for businessmen and other people who do not have the time for the more vigorous type of exercise. There is no danger of strain. When a muscle is in a static contraction, whatever the load, it can't be injured. Sudden motion, like a halfback reversing his field, is what causes injuries."[15]

Richards has put on the backs of the Wheaties cereal boxes a group of isometric exercises with which to build strength and physical fitness. Steinhaus says of the exercises:

> It has been proved that exercising any muscle strenuously for just six seconds six times a day will cause it to grow stronger as fast as it can grow. For your heart and lungs, do some fast walking, or other activity every day that makes you slightly breathless."[16]

The Royal Canadian Air Force 5BX eleven-minute-a-day exercise plan for men has been shown to:

> Increase the strength of the important muscle groups needed in everyday living; increase the ability of

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[14] Ibid., pp. 15-21.

[15] Osborn Elliott, "Oof!" Newsweek, 59:78, January, 1962.

[16] Bob Richards, Wheaties Sports Federation, Minneapolis, Minnesota.

> muscles used in essential body movements to function efficiently for long periods of time; increase the speed response of the important muscles of the body; keep the important muscles and joints of the body supple and flexible; improve the efficiency and capacity of the heart, lungs and other body organs; increase the capacity for physical exertion."[17]

The following statement from the RCAF fitness program handbook tells what the program is:

> The 5 BX plan is composed of six charts arranged in progression. Each chart is composed of five exercises which are always performed in the same order and in the same maximum time limit, but, as one progresses from chart to chart, there are slight changes in each basic exercise with a gradual demand for more effort."[18]

Review of literature indicated there are tests in which strength can be assessed. The test of McCurdy, Martin, McCloy, Rogers, and Sargent may be considered as fairly representative of the tests available in the field.[19] Objective strength testing probably began when Frederick Rand Rogers developed the Rogers Strength Index and Physical Fitness Index.[20] Rogers Strength Index was a measure of the muscle groups of the body.

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[17]William I. Nichols (ed.), Royal Canadian Air Force Exercise Plan for Physical Fitness (New York: United Newspapers Magazine Corporation, 1962), pp. 53.

[18]Ibid., p. 64.

[19]John F. Bovard and Frederick W. Cozens, Tests and Measurements in Physical Education (London: W. B. Saunders Company, 1935), pp. 74-89.

[20]H. Harrison Clarke, Application of Measurement to Health and Physical Education (third edition: Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1960), pp. 184-200.

In 1931, McCloy developed a classification index using the chinning and dipping tests of the original Rogers Index.[21] In 1953, Mosley and others reported the test re-test reliability of the McCloy revision to be .97; McCloy reported a .95 reliability in his report on the test.[22]

Experimenters have used some part of an over all testing matrix to estimate the gain or loss of strength in experimental situations. In 1944 Doscher used chins and dips, employed in the Rogers and McCloy tests, and jumps and squat thrusts to measure performance changes in wrestlers, boxers, and college students. Andrews reported a study in which Keys used left and right hand strength and back strength as measures of muscle strength.[23]

Mechanical measurements of strength have been assessed by the use of the hand dynamometer and the leg/back dynamometer for measuring strength. Hunsicker and Connelly reported, "The dynamometer, especially the spring

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[22]John W. Mosley, Ara Hacrabedian, and Donold D. Donaldson, "Weight Training in Relation to Strength, Speed, and Coordination, Research Quarterly, 24:308-315, October, 1953.

[23]Sydney H. Andrews, "The Effect of Liquid Diet on Selected Physical and Mental Capacities," (unpublished Dissertation, The University of Denver, Denver, Colorado, 1965), p. 26; and Ancel B. Keys, et al., The Biology of Human Starvation (2 Vols.; Minneapolis: University of Minnesota Press, 1930).

steel type, has been the principal instrument utilized for strength testing."[24] While all of these tests measure the strength of the testee, push-ups (dips) and leg/back dynamometer strength tests of the Rogers Physical Fitness Index were selected for use in this study to assess major muscle strength of the experimental groups.

A recent study of Flint and Gudgell compared the variations in performing the sit-up exercise and found that a curl-up type sit-up required greater muscle activity throughout the total movement than any other variation.[25]

Other studies by Partridge, Walters, Kendall, and Shoffield concur with Flint and Gudgell, that the trunk curl required greater muscle activity throughout the total movement than any other sit-up variation.[26]

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[24]Paul A. Hunsicker and Richard J. Connelly, "Instruments to Measure Strength," Research Quarterly, 26:408-420, December, 1955.

[25]Marilyn M. Flint and Janet Gudgell, "Electromyographic Study of Abdominal Muscular Activity During Exercise," Research Quarterly, 36:29-37, 1965.

[26]Gary L. Soderberg, "Exercises for the Abdominal Muscles," Journal of Health, Physical Education, and Recreation, 37:69, September, 1966; and Miriam J. Partidge and Etta Walters, "Participation of the Abdominal Muscles in Various Movements of the Trunk in Man," American Journal of Physical Therapy, 39:791-800, 1959; and Frederick J. Sheffield, "Electromyographic Study of the Abdominal Muscles in Walking and Other Movements," American Journal of Physical Medicine, 41:142-147, 1962; and Florence R. Kendall, "A Criticism of Current Tests and Exercises for Physical Fitness," Journal of American Physical Therapy Association, 45:187-197, 1965.

Endurance

A study was done by Howell on isometrics and endurance. Howell tested three groups of eleven subjects enrolled in required physical education classes. The test consisted of bicycling for two minutes on an ergometer. Group A employed weight training exercises, Group B used the Commander Set Series of isometric contractions, and Group C only participated in the physical education classes. Following the eight-week training period all subjects were again tested. Both experimental groups (Groups A and B) showed significant difference between the two groups. Howell hypothesized that increases in muscular endurance may be produced by isometric programs as well as by isotonic programs.[27]

An experiment was done by Thompson in relation to isometric exercise and endurance. He concurs with Howell that isometric exercise can improve endurance as well as isotonic exercise.[28]

According to these experiments, it appears that isometric contraction type exercise is of value in development of muscular endurance as well as muscular strength.

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[27]Maxwell L. Howell, "Effects of Isometric and Isotonic Exercise Programs Upon Muscular Endurance," Research Quarterly, December, 1962.

[28]Clem W. Thompson, "Some Physiologic Effects of Isometric and Isotonic Work in Man," Research Quarterly, 25:476, December, 1954.

CHAPTER III

FINDINGS

The findings were reported in three tables. The findings in the first table were concerned with the statistical evidence reported between the two experimental groups when tested before the conditioning period began. The second table was concerned with the statistical evidence reported between the two experimental groups when tested before and after the conditioning period ended. The third table was concerned with the statistical evidence reported within the two experimental groups before and after the conditioning period began.

Findings, Table I. Table I represents the pre-test means for the variables tested between the isometric and RCAF groups. The between group means indicated a difference in all cases. The F test revealed that the two groups were evenly matched at the .05 level of confidence. The t test revealed that there were significant differences in endurance capacity and leg lift at the .05 level of confidence between the two experimental groups. There were no significant differences in push-ups (dips) and sit-ups between the two experimental groups.

TABLE I

THE MEANS, F VALUES, AND t VALUES FOR THE PRE TESTS VARIABLES OF THE STRENGTH AND CARDIOVASCULAR MEASURES OF PHYSICAL FITNESS

	M	F	t
Endurance Capacity		1.24	6.29*
Isometric	65.05		
RCAF	66.68		
Push-ups (dips)		1.54	.086
Isometric	12.05		
RCAF	11.50		
Leg Lift		1.07	5.27*
Isometric	193.31		
RCAF	205.80		
Sit-ups (curl)		1.92	.082
Isometric	47.55		
RCAF	40.73		

*Significant at the .05 level of confidence.

Findings, Table II. Table II represents the post-test means for the variables tested between the isometric and RCAF groups. The between group means indicated a difference in all cases. The F test revealed that the two groups were evenly matched at the .05 level of confidence. The t test revealed that there were significant differences at the .05 level of confidence between the two experimental

TABLE II

THE MEANS, F VALUES, AND t VALUES FOR THE POST TESTS VARIABLES OF THE STRENGTH AND CARDIOVASCULAR MEASURES OF PHYSICAL FITNESS

	M	F	t
Endurance Capacity		1.13	5.12*
Isometric	60.95		
RCAF	57.27		
Push-ups (dips)		1.49	4.34*
Isometric	14.04		
RCAF	17.13		
Leg Lift		1.05	18.36*
Isometric	203.00		
RCAF	247.77		
Sit-ups (curl)		1.10	1.95
Isometric	61.04		
RCAF	58.59		

*Significant at the .05 level of confidence.

groups in endurance capacity, push-ups (dips), and leg lift. There were no significant differences between the two experimental groups in sit-ups (curl).

Findings, Table III. Table III represents the Pre and Post tests means for the variables tested within the isometric and RCAF group. The Pre and Post test means of the isometric group revealed significant differences in Endurance capacity, Push-ups (dips), leg lift, and sit-ups (curl) at the .05 level of confidence. The Pre and Post test means of the RCAF group revealed significant differences in Endurance capacity, push-ups (dips), leg lift, and sit-ups

TABLE III

THE t VALUES FOR THE PRE AND POST TESTS VARIABLES OF THE STRENGTH AND CARDIOVASCULAR MEASURES OF PHYSICAL FITNESS WITHIN THE TWO EXPERIMENTAL GROUPS

	Pre-test M	Post-test M	t
Endurance Capacity			
Isometric	65.05	60.95	9.53*
RCAF	66.68	57.27	14.40*
Push-ups (dips)			
Isometric	12.05	14.04	5.130*
RCAF	11.50	17.13	10.921*
Leg Lift			
Isometric	193.31	203.00	11.327*
RCAF	205.80	247.77	7.870*
Sit-ups (curl)			
Isometric	47.55	61.04	13.944*
RCAF	40.73	58.59	20.809*

*Significant at the .05 level of confidence.

at the .05 level of confidence.

The isometric and RCAF t tests within the two experimental groups revealed that there were significant differences in endurance capacity, push-ups (dips), leg lift, and sit-ups within each of the two experimental groups.

CHAPTER IV

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary

The purpose of this study was to ascertain the difference, if any, between the RCAF fitness program and Bob Richards' isometric contraction program in relation to selected muscular and cardiovascular measures. The physical capacities measured were strength and cardiovascular response to exercise between two groups subjected to separate methods of physical conditioning.

Subjects for this study were drawn at Appalachian State Teachers College. The subjects were eighteen to twenty-four years of age. The forty-four subjects were divided into two groups, twenty-two in each group. The two groups were matched as evenly as possible according to the individual strength of each subject.

Each experimental group was subjected to a different physical fitness program. The selected muscular and cardiovascular tests were administered to each group before the conditioning period began and after the conditioning period ended.

It was hypothesized that there would be no significant differences, due to the two different programs of conditioning imposed on the two experimental groups, in

relation to the group means of the tests variables. The hypothesis was tested by comparing the two group means before the conditioning began and again after the conditioning period ended.

Conclusion

The t test in Table I revealed that there were significant differences in endurance capacity and leg lift at the .05 level of confidence and no significant differences in push-ups (dips) and sit-ups between the two experimental groups. Testing within the RCAF group showed significant gains in sit-ups (curl), push-ups (dips), leg lifts, and a reduction of pulse rate after exercise. Testing within the isometric group showed significant gains in sit-ups (curl), push-ups (dips), leg lifts, and a reduction of pulse rate after exercise. These gains being significant from zero. It may be assumed that these changes were due to the conditioning imposed on the two experimental groups.

The experimental RCAF group showed a mean reduction in pulse rate after exercise of nine and one-half beats per minute. The isometric group showed a mean reduction in pulse rate after exercise of two and one-half beats per minute. These pulse rate reductions were significant.

All of the strength variables measured before and after the conditioning began showed significant changes within the two experimental groups. The null hypotheses

were not accepted.

Statistical evidence showed that isometric and isotonic exercises are both suited for gain in strength and increase of endurance capacity when pulse rate decrease is desired. It seems that the RCAF program showed a greater mean reduction of pulse rate after exercise than did the isometric program. Therefore it was recommended that isometric and isotonic exercises be combined when strength and endurance are desired outcomes as a part of physical fitness.

Recommendations for Further Study

(1) Studies similar to the one reported in this thesis should be undertaken with individual subject's weight used as one of the variables.

(2) Future studies in the same area as this research project should include women of various ages.

(3) Due to the small number of subjects used in this study, similar studies should be undertaken in an attempt to verify the findings and results reported in this study.

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APPENDIX

One in a series. Look for all 8 on Wheaties Packages:

These quick exercises can help you keep in shape. The eminent physiologist, Dr. Arthur H Steinhaus, Professor and Dean Emeritus of George Williams College, Chicago, says: "It has been proved that exercising any muscle strenuously for just 6 seconds 6 times a day will cause it to grow stronger as fast as it can grow. For your heart and lungs, do some fast walking, or other activity every day that makes you slightly breathless."

After you get started on this simple fitness program, you may want a larger variety of exercises. The U.S. Official Physical Fitness Program, published in illustrated book form by the President's Council on Physical Fitness, gives graded instruction for five levels of fitness for men and women. You can get this book for just 25¢ from General Mills; see the side panel on this package.

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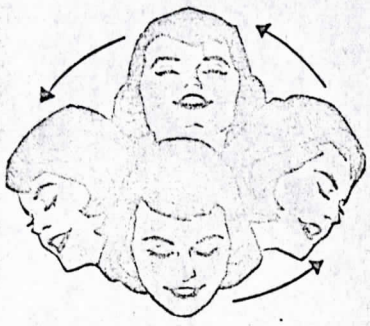
1. How To Relax; 2. Limbering Up; 3. Improve Your Posture; 4. Watch That Waistline; 5. Everyday Tips; 6. Waking Up Exercises; 7. Quick and Simple; 8. Do It the Right Way.

EXERCISE SHEET
NUMBER ONE

Tense muscles cut off their own circulation, making you tired faster. Relaxation is vital to fitness.

HOW TO RELAX

Relax in your chair. You can use a pencil as a "timer." Hold the pencil loosely in your hand, then let all your muscles go limp. When the pencil drops involuntarily from your fingers, chances are you're completely relaxed. Total relaxation a few times a day relieves tension, postpones fatigue.



Roll your head in a large circle on your shoulders. Just do this for about 6 seconds and you'll notice a decrease in muscle tension. While you're at it, you might try tensing and relaxing your facial muscles. Relaxing a muscle is just the opposite of tensing it. Remember this and you'll find it easier to relax.

Here's a specific muscle exercise that will help you learn to relax. Sharply clench your fist – then suddenly let go completely. Practice this a few times, then try another part of the body. This will help give you more control over your muscles.

FOR COMPLETE PHYSICAL FITNESS PROGRAM SEE SIDE PANEL →

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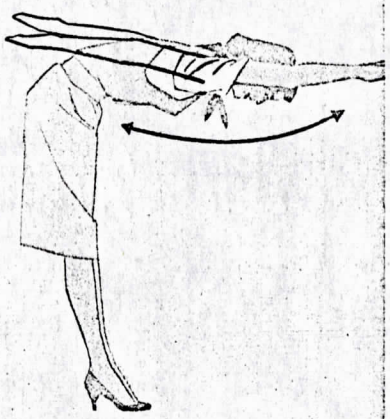
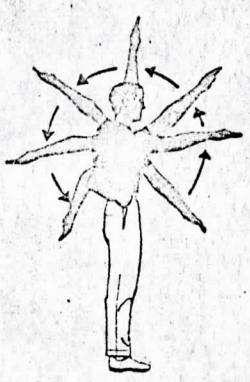
EXERCISE SET NUMBER TWO

Your everyday tasks become easier, requiring less effort, if your muscles are loose and flexible.

LIMBERING UP



Here's something you can do for just 6 seconds first thing in the morning to limber up. Bend forward with arms hanging loosely. Swing your arms back and forward keeping back straight. (You may want to touch the floor also.)



Stand with your feet apart, right hand on hip. Swing left arm vigorously around in a complete circle – forward upward, and backward downward. Repeat with right arm. Just 6 seconds of this will help loosen tight or tense muscles.

For warm-up and flexibility, try this simple three-part exercise. Squat, placing hands on floor in front of feet. Straighten your knees. Return to a standing position. Just a few of these will help keep normal joints flexible.

This ballet kick is great a bering up exercise. Sta sideward, shoulders level the palm of your right h left foot, moving the hea possible. Repeat to other

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EXERCISE SET NUMBER THREE

You'll look and feel better if your posture is good. Posture is an important aspect of total fitness.

IMPROVE YOUR POSTURE

Stand tall. Put your heels together, your toes on a line on the floor. Then close your eyes. You'll find, surprisingly, that you must stand straight and erect to keep your balance. Try this often for 6 seconds each time, and you'll find your posture improving.

Stand with your left arm extended high over your head. Reach up as high as possible while keeping your heels on the floor. Repeat with the right arm. Try this daily for just 6 seconds. It'll help your posture, as well as develop your upper arm and shoulder.

Sit with your legs crossed tailor-fashion, hands to chest, palms down. Be sure to keep your back straight, head up, chin in. Now, move your elbows back, then return. This is good for your posture, and, girls, it helps make your back and shoulders more attractive for off-the-shoulder fashions.

Here's an easy posture- once a day. Start with yo then swing your arms up ur and swing carry yo then stretch. This will your circula jon and bre as your posture.

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Director, Wheaties Sports F

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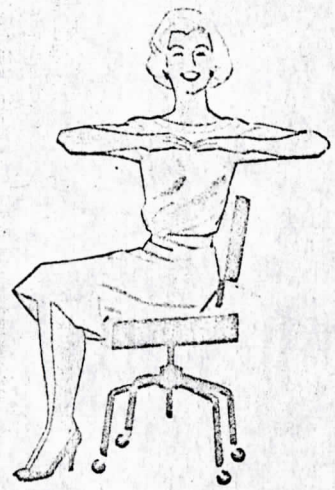
EXERCISE SET NUMBER FOUR

A sensible diet and a little exercise is all you need to keep trim. Try these 6 second exercises for firming up your waistline.

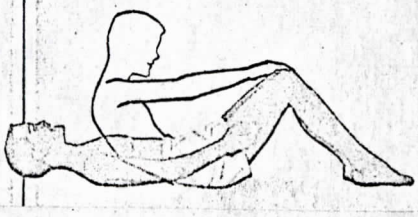
WATCH THAT WAISTLINE

Try this for just 6 seconds, 6 times a day: pull in your stomach, stick out your chest, and tighten your abdominal muscles; simply go on breathing normally. The trick is to remember to do this every day. Try pulling in your stomach for 6 seconds whenever the phone rings, for example.

Here's an easy tummy-flattener that just takes 6 seconds! and can be done any time of the day. Sit tall with hands at chest level and elbows shoulder high. Twist vigorously to the left, then to the right. Try this 6 times a day — at school, at work, at the breakfast table before eating.



Try this very brief exercise: lie flat on your back, hands on thighs, knees bent, feet flat on floor. Raise your head and shoulders enough to touch kneecaps with fingers; then lower. Do this 6 times a day. It can well be done before getting out of bed in the morning.



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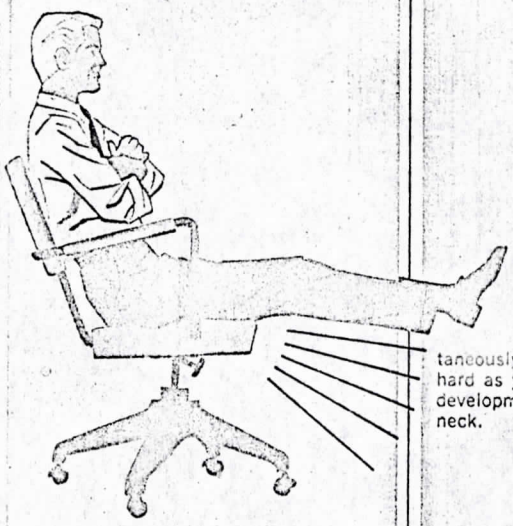
EXERCISE SET NUMBER FIVE

Exercise has little effect unless it is done regularly. Try to incorporate these exercises into your daily routine.

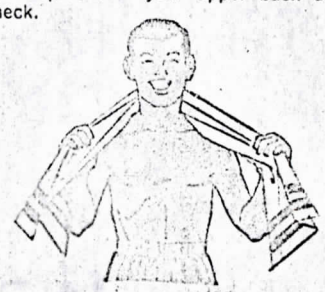
EVERYDAY TIPS



While sitting at home or at work, occasionally raise your legs and hold them up for 6 seconds; then lower them slowly. Try this leg-conditioner off and on through the day, whenever you think of it. It will help firm your legs and contribute to easier walking.

Here's a simple tip that will make you look and feel more fit with virtually no effort. Simply remember to stand as much as possible without support when dressing and undressing. Make a practice of this, and it will firm your legs and improve posture.

When drying with a towel after a bath or a swim, try this for 6 seconds. Put the towel in the nape of your neck, pull it forward and with chin down simultaneously push your neck against it as hard as you can. This will help muscle development in your upper back and neck.



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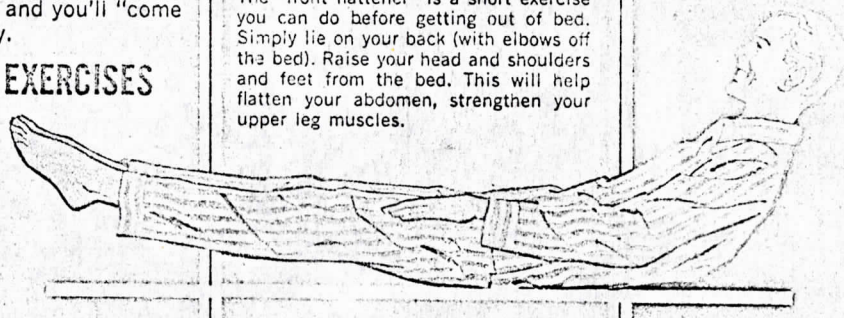
EXERCISE SET NUMBER SIX

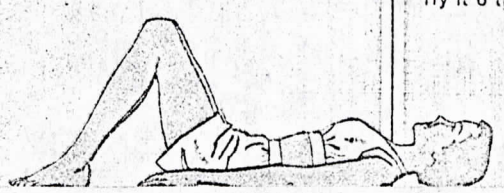
Find it hard to wake up in the morning? Try these 6 second exercises first thing, and you'll "come alive" right away.

WAKING UP EXERCISES

The "front flattener" is a short exercise you can do before getting out of bed. Simply lie on your back (with elbows off the bed). Raise your head and shoulders and feet from the bed. This will help flatten your abdomen, strengthen your upper leg muscles.



As an aid in posture improvement, try this for 6 seconds first thing in the morning. Lie on your back, knees bent, feet flat on the bed. Contract abdomen, pushing lower back down. Then relax. Helps flatten the tummy, too.



Rest on hands and knees, arms extended with hands in direct vertical line under shoulders, and knees in line under hips. Raise lower back and at the same time contract your abdominal muscles. Then relax. Try it 6 times for just 6 seconds.

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WHEATIES

Try these 6-SECOND exercises

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EXERCISE SET NUMBER SEVEN

Exercise doesn't have to be a hard grind. Here are some exercises which virtually anyone can do — and from which nearly everyone can benefit.

QUICK AND SIMPLE

An almost effortless exercise like this one will help improve your posture and make your back more attractive. 6 times a day, sit with your feet flat on the floor, clasp your hands around your knees, relax forward. Then arch your back, lifting chest and head.

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EXERCISE SET NUMBER EIGHT

There's a right and wrong way to do everything. Here are some tips on how to do a few physical things the right way. They require less effort in the long run, and they contribute to your fitness.

DO IT THE RIGHT WAY

You can improve your posture, become more fit, by simply doing your daily chores the right way. When ironing, for example, keep your back and arms as straight as possible. If you scrub the floor, scrub with back straight and weight from shoulders on brush.

Did you know there's a right and a wrong way to sit? There is. To improve your posture and stave off fatigue, remember to sit tall with your hips against the back

PHYSICAL CAPACITY RATING SCALE

LEVEL	EXERCISE					1 mile walk	2 mile walk
	1	2	3	4	5	In minutes	
A+	30	32	47	24	550	8	25
A	30	31	45	22	540	8	25
A-	30	30	43	21	525	8	25
B+	28	28	41	20	510	8¼	26
B	28	27	39	19	500	8¼	26
B-	28	26	37	18	490	8½	26
C+	26	25	35	17	480	8½	27
C	26	24	34	17	465	8½	27
C-	26	23	23	16	450	8½	27
D+	24	22	31	15	430	8¾	28
D	24	21	30	15	415	8¾	28
D-	24	20	29	15	400	8¾	29
Minutes for ea. exercise	2	1	1	1	6		

*Reproduced from the RCAF Manual, 5BX eleven-minute-a-day plan for men.

CHART 2

1. Feet astride, arms upward.
   -Touch floor 6" outside left foot, again between feet and press once then 6" outside right foot, bend backward as far as possible, repeat, reverse direction after half the number of counts.
2. Back lying, feet 6" apart, arms clasped behind head.
   -Sit up to vertical position, keep feet on floor, hook feet under chair, etc., only if necessary.
3. Front lying, hands interlocked behind the back.
   -Lift head, shoulders, chest and both legs as high as possible.
   -Keep legs straight, and raise chest and both thighs completely off floor.
4. Front lying, hands under the shoulders, palms flat on floor.
   -Touch chin to floor in front of hands--touch forehead to floor behind hands before returning to up position.
   -There are three definite movements, chin, forehead, arms straightened. DO NOT do in one continuous movement.
5. Stationary run-(Count a step each time left foot touches floor.) Lift feet approximately 4 inches off floor. After every 75 steps do 10"half knee bends." Repeat this sequence until required number of steps is completed.

   Half knee bends-Feet together, hands on hips, knees bent to form an angle of about 110°. Do not bend knees past a right angle. Straighten to upright position, raising heel off floor, return to starting position each time.

PERSONAL DATA AND TEST SCORE CARD

Name of Subject _____

Age _____ Height _____ Weight _____

Test	First Test Score	Second Test Score
Harvard Step Test		
Rogers Floor Dynamometer (legs)		
Rogers Push-ups (dips)		
Sit-ups (curl)		

THE IDENTIFICATION NUMBER, PRE TESTS SCORES, AND POST TESTS SCORES OF THE STRENGTH AND CARDIOVASCULAR MEASURES OF PHYSICAL FITNESS FOR EACH MEMBER OF THE EXPERIMENTAL HCAF GROUP

I.D.	Cardiovascular Capacity HCAF		Push-ups (dips) HCAF		Leg Lift HCAF		Sit-ups (curl) HCAF	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	78	64	21	27	315	365	75	89
2	74	63	16	20	310	380	60	82
3	74	67	15	23	300	326	59	71
4	73	61	15	23	250	267	58	76
5	72	64	14	22	250	320	54	69
6	71	59	14	18	250	259	50	73
7	70	59	14	19	250	320	45	69
8	70	60	13	13	248	279	41	80
9	69	56	12	16	230	270	41	56
10	69	61	11	15	225	237	40	60
11	69	62	11	20	225	249	39	54
12	69	58	10	20	200	230	36	81
13	68	57	10	15	185	210	36	53
14	67	57	10	16	180	230	35	43
15	66	58	9	13	156	249	35	70
16	65	54	9	14	152	225	34	44
17	62	52	9	11	150	235	33	39
18	62	50	9	15	150	183	32	45
19	59	59	9	17	149	173	30	65
20	59	44	8	14	149	184	26	45
21	58	50	7	9	125	170	25	28
22	56	46	5	11	100	123	23	38

THE IDENTIFICATION NUMBER, PRE TESTS SCORES, AND POST TESTS SCORES OF THE STRENGTH AND CARDIOVASCULAR MEASURES OF PHYSICAL FITNESS FOR EACH MEMBER OF THE EXPERIMENTAL ISOMETRIC GROUP

I.D.	Cardiovascular Capacity Isometric		Push-ups (dips) Isometric		Leg Lift Isometric		Sit-ups (curl) Isometric	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	84	79	30	37	327	335	110	129
2	77	74	18	20	325	331	101	120
3	76	76	17	21	315	320	82	108
4	69	67	16	23	255	275	72	84
5	69	65	15	15	227	237	61	72
6	68	66	14	21	225	235	52	65
7	67	64	14	21	225	232	52	67
8	67	63	13	14	225	237	50	41
9	66	63	13	17	209	215	47	60
10	66	63	13	19	200	214	40	65
11	65	63	13	16	200	215	40	58
12	65	64	12	19	175	188	38	53
13	65	63	11	14	168	171	36	40
14	64	61	11	16	156	164	36	51
15	63	60	10	14	155	170	35	61
16	61	58	10	12	155	165	32	47
17	61	61	9	11	154	170	30	55
18	59	59	9	7	125	143	30	49
19	58	56	6	9	125	144	29	42
20	55	52	5	11	125	143	28	44
21	52	51	5	10	110	125	28	41
22	51	50	3	7	104	119	18	28

ABSTRACT

A COMPARISON OF THE RCAF PHYSICAL FITNESS PROGRAM AND BOB RICHARDS' ISOMETRIC CONTRACTION PROGRAM IN RELATION TO SELECTED MUSCULAR AND CARDIOVASCULAR MEASURES

An Abstract of a Thesis

Presented to

The Faculty of the Graduate School

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of the Requirements for the Degree

Master of Arts

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by

Bruce Patterson Sams

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ABSTRACT

The purpose of this study was to ascertain the difference, if any, between the RCAF fitness program and Bob Richards' Isometric contraction program in relation to selected muscular and cardiovascular measures. The physical capacities measured were strength and cardiovascular response to exercise between two groups subjected to separate methods of physical conditioning.

Subjects for this study were drawn from forty-four white male Appalachian State Teachers College students eighteen to twenty-four years of age, volunteers from a freshmen physical fitness class. The forty-four subjects were divided into two groups, twenty-two in each group. The two groups were matched as evenly as possible according to the individual strength of each subject.

Each experimental group was subjected to a different physical fitness program. The selected muscular and cardiovascular tests were administered to each group before the conditioning period began and after the conditioning period ended.

It was hypothesized that there would be no significant differences, due to the two different programs of conditioning imposed on the two experimental groups in relation to the group means of the tests variables. The hypothesis was tested by comparing the two group means before the conditioning began and again after the conditioning

period ended.

Testing the means of the experimental RCAF group and the isometric group showed gains in sit-ups, push-ups, leg lifts, and a reduction of pulse rate after exercise. It may be assumed that these changes were due to the conditioning imposed on the two experimental groups.

The experimental RCAF group showed a mean reduction in pulse rate after exercise of nine and one-half beats per minute. The isometric group showed a mean reduction in pulse rate after exercise of two and one-half beats per minute. These pulse rates reductions were significant.

All of the strength variables measured before and after the conditioning began showed significant changes within the two experimental groups. The null hypotheses were not accepted.

Statistical evidence shows that isometric and isotonic exercises are both suited for gain in strength and increase of endurance capacity when pulse rate decrease is desired. It seems that the RCAF program shows a greater mean reduction of pulse rate after exercise than does the isometric program. Therefore, it was recommended that isometric and isotonic exercises be combined when strength and endurance are desired outcomes as a part of physical fitness.